REMARKS

The present paper is in response to the final Office Action of September 14, 2004 and constitutes the submission required under 37 C.F.R. § 1.114.

Claims 9-20 remain in the case.

As discussed in the subject application, an object of the present invention is to reduce significantly the weight and thickness (volume) of an air bag while maintaining the mechanical properties of the air bag as well as durability against long-term aging. The basis weight and thickness of the fabric for an improved air bag are reduced by about 20%, preferably 30% or more, when compared with a conventional base fabric used in a conventional air bag. (See application, page 3, line 30 to page 4, line 19.)

In the present invention, a significant mechanical property of the fabric is tensile work at break. Tensile work at break of the woven fabric forming the air bag was found to be more relevant from a design standpoint than the tensile strength at break. During the making of the invention, the applicants noted that the dynamic load exerted on the air bag is larger at the stage when the air bag is projected forward to a maximum extent (See application, Fig. 1(3)) than at the stage when the air bag inflates to a maximum extent and restrains the occupant. (See application, page 8, line 22 to page 9, line 1.) This study unexpectedly resulted in tensile work at break being more significant than tensile strength at break.

Tensile work of a fabric is generally correlated to the basis weight of the woven fabric if the kind of yarn is specified. It is significant in the present invention that an unnecessarily large tensile work at break is contradictory because weight reduction and compactness of the present air bag are important requisites. Because the kinetic

energy of the air bag projected forward must be absorbed by the tensile work of the woven fabric forming the air bag in the projecting stage, the woven fabric forming the air bag must have a tensile work at break enough to absorb the kinetic energy but must not be unnecessarily large. Tensile work at break is specified in the independent claims in the range of 7,000 to 30,000 N•%/2.54 cm.

The air bag according to the present invention is excellent in weight reduction and pliability so that a favorable compactness is obtainable if the fabric is composed of yarns (warp and weft), each consisting of a plurality of filaments having a total fineness in a range from 66 to 167 decitex and a single filament fineness in a range fro 1.0 to 3.3 decitex, and has the above-identified tensile work at break.

The woven fabric of the present invention is specified in terms of a parameter, weave fineness, which is a product of total fineness of warp or weft multiplied by weave density, the product being 16000 decitex•end/2.54 cm or less. The basis weight of woven fabric is directly correlated to the weave fineness. The value range of the load at 15% elongation of the fabric is specified in order to obtain a pliable air bag that prevents occurrence of injury of the vehicle occupant at impact. The mechanical properties are maintained even after the air bag has been exposed to prolonged periods of heat-aging, wet heat-aging, and ozone-aging.

The rejections under 35 U.S.C. § 103(a) of claims 10, 11, 13, 15, and 17-20 based on Toray, of claims 9, 14, and 16 based on Toray in view of Smith, and of claim 12 based on Toray in view of Mizuki are respectfully traversed.

The Examiner's attention is invited to Table A and Table B filed with the RCE of August 25, 2003, and Table A (Revised) filed herewith. As understood by a comparison

of Tables A with Table B, the fabrics of the Toray Examples and Comparative Examples clearly have different levels of yarn fineness (size) (350 to 470 dtex) and weave fineness values (21620 to 31020) than the levels claimed herein. Further, the yarn size usable in Toray cannot practically be smaller than 210 denier (=231 dtex); 210 denier yarn is stated by Toray to be the desirable minimum for attaining the objective mechanical properties (e.g., tensile strength, tensile elongation, tear strength).

Based on applicants' calculation in Table B, the level of the estimated basis of weight of the uncoated woven base fabrics of Toray Examples and Comparative Examples is 170 to 244 g/m^2. These levels of basis of weight of Toray fabrics are similar to those of conventional base fabrics as referred to in the present application. (See application, page 3, line 30 to page 4, line 21). In contrast, the level of measured basis of weight of the six present Examples in Table A is 94 to 125 g/m^2.

It is submitted that Toray suggests it would not be possible to use a yarn having a decitex of 66 to 167, far less than Toray's lower limit of 210 denier (231 decitex), to produce a woven fabric for use in making a lightweight airbag. In accordance with the teachings of Toray, a woven base fabric for an airbag is designed by relying on the tensile strength at break of the base fabric and stating that 210 denier yarn is the desirable minimum for attaining the objective mechanical properties. Since the Toray teachings lack consideration for the importance of tensile work at break of fabric, a skilled person in the art could not predict what range of yarn size and what woven structure would make a lighter and thinner air bag, yet resistance against dynamic load upon inflation. Even Toray's fabric strength at break is significantly greater than the claimed range of 740 to 1010 N/2.54cm appearing in each of the independent claims.

Although Toray fails to recognize the importance of applicants' discovery of using tensile work at break in inventing the claimed air bag, an incorrect statement concerning Toray and this property was previously made to the Examiner. In "Table B Toray Example and Comparative Examples" prepared by applicants, the estimates of Toray's tensile work at break would not be outside the claimed range but instead overlap. Applicants and the undersigned attorney apologize for inadvertently attempting to distinguish Toray previously based on the value of tensile work at break of Toray's fabric.

As to the secondary reference to Smith, the shortcomings of Toray discussed above apply equally here for claim 9. The addition of Smith, assuming arguendo that it is combinable with Toray, does not correct these shortcomings. Furthermore, Smith's air bag is formed preferably of a neoprene backing layer. Because the Toray air bag employs a base fabric for an uncoated air bag, an attempt to provide Toray with a negative backing layer would be contrary to Toray's teachings and unsupportable for this reason alone.

Mizuki discusses the well-known factor of birefringence, but this discussion does not correct shortcomings of Toray discussed above. Further, Mizuki does not teach the requirement in claim 12 that the birefringence of the weft is larger than that of the warp. The Examiner's solution is again "routine optimization" until the birefringence of the weft is larger than that of the warp. Not only does this approach deprecate the invention, it overlooks completely the technical significance of this claimed feature, namely, to make the mechanical properties substantially the same in the warp and weft directions of the fabric. See application, page 10, lines 26 to 36. While it is plausible that Toray would

have birefringence as high as needed for obtaining a high-strength yarn, the technical relationship of warp yarn to weft yarn, as recited in claim 12, is neither taught nor made obvious by either Toray or Mizuki. Additionally, neither of their respective teachings lays a groundwork for invoking the "routine optimization" solution of the Examiner for correcting the deficiencies of a reference.

The Examiner's attention is invited to U.S. Patent No. 5,533,755 to Nelsen et al. ("Nelsen") a copy of which was submitted with the Information Disclosure Statement filed September 5, 2000. Fabric No. 64145 (Table 1, col. 7) in Nelsen is included in the attached Table C. As understood, Nelsen describes nylon 66 yarn as preferred yarn for forming a fabric for making the specifically configured cushion (airbag) but is silent about any use of copper compound modified nylon 66 yarn. Further, the specifications of both Fabric No. 64145 formed of T-185 DuP nylon 66, 70 denier/34 filaments as warp and T-1943 ICI nylon 66 yarn, 100 denier/34 filament as weft in Table 1 at column 7 provides no positive reason why these nylon 66 yarns should be of a copper compound modified type nylon 66 yarn. Claims 9, 10, and 17 differ from Fabric No. 64145 in this first respect.

The basis of the new recitation in claims 9, 10, and 17: "the yarn having a tensile strength of 5.4 cN/dtex or greater" is found in Table A (Revised). (See esp. Example 3, yarn, tensile strength box.) Table A (Revised) is summary data of physical and mechanical properties of the fabrics according to present Examples (EX) 1 to 6 and Comparative Examples (CE) 1 to 4 of the present invention (See application, Table 1, page 19 as amended). Table C attached is summary data of physical and mechanical properties for fabrics including Fabric No. 64145 of the Nelsen patent. As understood,

in Table C, the estimated values of strength of the yarns for warp and weft were calculated by using values in Table 1, column 7, of Nelsen. From a comparison of Table A (Revised) with Table C, although the total and filament size of yarn as well as weave fineness of fabrics are substantially at the same level, Fabric No. 64145 has a smaller value of tensile strength in the warp and weft directions (436 N/2.54cm and 525 N/2.54cm) than those of the fabrics according to the present Examples in Table A (Revised). This low strength value of Fabric No. 64145 is assumed to be the result of use of a low tensile strength yarn (3.7 cN/dtex for warp-Table C), while the claims herein recite a range of 5.4 cN/dtex or greater.

Reconsideration and allowance of claims 9-20 are earnestly solicited.

Please grant any additional extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

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Attachments: Tables A (Revised) and Table C

Table A (revised) Present Examples (EX) and Comparative Examples (CE)

	EX1		EX2		EX3		EX4		EX5		EX6		CE1		CE2		CE3		CE4	
Fabrics																				
Weave density ends/2.54 cm; picks/2.54 cm	95	93	95	93	95	93	90	98	94	94	142	142	95	93	95	93	192	190	78	75
Strength at break kg/3 cm N/2.54 cm	1010	930	900	850	770	740	963	983	951	941	760	740	998	872	1000	871	564	559	1326	1275
Tensile work (Estimated.) N·%/2.54 cm	17675	12555	20250	14450	20790	15910	16853	13271	19020	12704	14060	9620	17465	11336	18000	11323	7050	6988	21216	19125
(measured value)	20500	13500	20600	14500	17500	13600	17800	14900	20500	14000	12500	8000	20000	12000	20500	12000	6000	5900	30000	25000
Tensile work/g-fabric (N·%/2.54 cm)/(g/m^2 × 1/2)	328	216	330	232	280	218	285	238	328	224	286	170	320	192	328	192	130	128	395	342
Cover factor	2224		2224		2224		2224		2224		2376		2224		2224		2701		2243	
Weave fineness dtex·end/2.54 cm; dtex·picks/2.54 cm	14820	14508	14820	14508	14820	14508	14040	15288	14664	14664	11076	11076	14820	14508	14820	14508	10752	10640	18174	17475
Elongation at break %	35	27	45	34	54	43	35	27	40	27	37	26	16	15	16	14	7	17	20	30
Basis of weight (measured) g/m^2	125		125		125		125		125		94		125		125		92		152	
Basis of weight (estimated) g/m^2	115		115		115		115		115		87		115		115		84		140	
(warp component, weft component)	58	57	58	57	58	57	55	60	58	58	44	44	58	57	58	57	42	42	72	69
Yarns (warp, weft)																				
yarn size dtex	156	156	156	156	156	156	156	156	156	156	78	78	156	156	156	156	56	56	233	233
denier	140	140	140	140	140	140	140	140	140	140	70	70	140	140	140	140	50	50	215	215
Fineness of single filament dtex/filament	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	1.6	1.6	6.7	6.7
Tensile strength cN/dtex	7.1		6.3		5.4		7.1		6.7 × 7.1		7.1		7.0		6.3		5.4		7.1	

Table C Examples described in U.S.P. 5,533,755

		#64144		#64145		#64146	
		Warp	Weft	Warp	Weft	Warp	Weft
Fabrics							
Weave density	ends/2.54 cm; picks/2.54 cm	184	96	153	90	128	68
Tensile strength	kg/3 cm						
	N/2.54 cm	458	578	436	525	770	761
Tensile work at break (Estimated)	N·%/2.54 cm (Calculated) (Measured Value)	5040	9801	8065	8136	10389	8747
Tensile work at break/g fabric	N·%·m^2/2.54 cm/g	139	236	172	209	187	214
Cover factor		2190		2180		2085	
Weave fineness	dtex·ends/2.54 cm.dtex·picks/2.54 cm	9200	10560	11934	9900	14080	10540
Elongation at break	%	22	34	37	31	27	23
Basis of weight (Measured)	g/m^2						
Basis of weight (Estimated)	g/m^2	78		86		97	
	(Warp component, Weft component)	36	42	47	39	55	41
Yarns (Warp, Weft)							
Fineness of yarn	dtex	50	110	78	110	110	155
	denier	45	100	70	100	100	140
Fineness of single filament	dtex/filament	3.3	3.2	2.3	3.2	3.2	6.0
Tensile Strength (Estimated)	cN/dtex	5.0	5.5	3.7	5.3	5.5	7.2